

**Interview Summary**

Application No.

10/528,904

Applicant(s)

HANSSON ET AL.

Examiner

Erica E. Cadugan

Art Unit

3722

All participants (applicant, applicant's representative, PTO personnel):

(1) Erica E. Cadugan.

(3)\_\_\_\_\_.

(2) Mr. Todd Taylor.

(4)\_\_\_\_\_.

Date of Interview: 21 September 2006.

Type: a)☒ Telephonic b)☐ Video Conference  
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.  
If Yes, brief description: \_\_\_\_\_.

Claim(s) discussed: See Exr. Amdt.

Identification of prior art discussed: none.

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: See Continuation Sheet.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

\_\_\_\_\_  
Examiner's signature, if required

## Summary of Record of Interview Requirements

### Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

### Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

#### Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

#### 37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,  
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

### Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: See Examiner's Amendment for agreed upon changes. Additionally, when the Examiner contacted Mr. Taylor about the Examiner's Amendment, the Examiner noted that the preliminary amendment filed 3/18/2005 indicated that a substitute specification as well as a marked-up copy thereof had been submitted to amend the specification, and also indicated that a replacement abstract had been filed. Examiner noted that no such substitute specification, marked-up copy thereof, or replacement abstract were anywhere to be found within the file, and asked if Mr. Taylor would fax the Examiner copies thereof. Mr. Taylor did so. .

# ATTACHMENT TO INTERVIEW SUMMARY

09/26/2006 14:42 260-897-9300

TAYLOR AUST PC

PAGE 01

## TAYLOR & AUST, P.C.

-----  
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### FACSIMILE COVER LETTER

To: Erica Cadugan (571-273-4474) Group Unit 3722

Company: USPTO

From: Todd T. Taylor

Re: US Patent Appl. Serial No. 10/528,904

Title: AN ASSEMBLY FOR REMOVING CHIPS FROM A CUTTING WORK AREA  
OF A CUTTING TOOL

Our ref: EIR0017.US

Comments: Per your request.

Total number of pages, including cover letter: 20

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An assembly for removing chips from a cutting work area of a cutting tool

CROSS Reference to Related Application

**Technical field**

BACKGROUND OF THE INVENTION

1. Field of the invention

*HP* The present invention relates to an assembly for removing chips and cuttings from a cutting working area of a cutting tool on a workpiece. The assembly of the present invention is adapted to be attached to either an axially movable, non-rotating component of a drilling/milling machine, and <sup>to</sup> be resiliently biased towards a workpiece in which a hole or a recess is ~~to be formed~~; or to be attached to a separate fixed support or stand located close to the workpiece, and <sup>to</sup> be resiliently biased towards the machine. In particular, but not exclusively, the assembly <sup>of the present invention</sup> is adapted to be used together with orbital drilling machines.

2. Description of the related art.  
**Background of the invention**

*HP* When forming holes or recesses in a workpiece by <sup>way</sup> means of a drilling or milling machine chips and cuttings generated by a cutting tool and remaining in the vicinity of the hole during the forming thereof can adversely effect the surface quality of the hole being formed.

*HP* What is needed in the art is a chips-removing assembly, which can efficiently collect and remove chips from a cutting working area while at the same time obtaining full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece during a working operation.

*HP* An object of the present invention is to provide a chips-removing assembly, which can efficiently collect and remove chips from a cutting working area while at the same time obtaining a full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece during a working operation.

*HP* For this purpose the assembly of the present invention comprises, in its simplest form, one form thereof a support structure for supporting a first end of an axially expandable and collapsible tubular member, a cross-piece for supporting a second end of the tubular member, at least one biasing spring configured and arranged for resiliently biasing the support

structure and the cross-piece away from one another, a housing with a chips-receiving chamber located adjacent one of ~~said~~ <sup>the</sup> ends of the tubular member for engagement with the working area of the workpiece, an outlet from the chamber of the housing being configured to be connected to a vacuum source for removing chips from the chamber, and a hub portion located at the other of ~~said~~ <sup>the</sup> ends of the tubular member for engagement with a cutting machine. During the working operating the tubular member surrounds the shaft of the cutting tool and defines a space which is substantially closed against a nose portion (e.g. a rotating spindle) of the working machine and which communicates with the chips-receiving chamber so as to improve the evacuation of chips therein and to create a safe protection for the operator in case of a breakdown of the cutting tool.

*An advantage of the present invention is that chips and cuttings from a cutting work area are efficiently removed.*  
 Further features and suitable embodiments of the assembly of the present invention are defined in the claims and will be described more in detail in the following description

under reference to the accompanying drawings.

*Another advantage of the present invention is that it provides full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece during a working operation.*  
 Brief description of the drawings  
*Another advantage of the present invention is an improved surface quality of the hole being formed.*

*1st Brief description of the drawings*  
 Fig. 1 is a perspective view of a first ~~simple~~ <sup>present</sup> embodiment of the assembly of the present invention;

Fig. 2 is perspective view of a second embodiment of the assembly of the <sup>present</sup> invention, as seen from a frontal side;

*Fig. 2*  
 Fig. 3 is perspective view of the second embodiment of the assembly of the invention, as seen from a rear side;

*of Fig. 2*  
 Fig. 4 is an end view of the second embodiment of the assembly;

Fig. 5 is a cross-sectional view taken along the line A-A in Fig. 4;

Fig. 6 is a perspective view of an orbital drilling machine to which the assembly of Fig. 2-5 is attached.

Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine coordinated with a third embodiment of a cuttings-removing assembly of the present invention;

Fig. 8 and 9 are perspective views of the assembly of Fig. 7, seen from the rear side thereof and in an axially collapsed and expanded position, respectively; and

Fig. 10 is a side view of a front portion of an orbital cutting machine and the third embodiment of the assembly in a retracted, unexpanded position in which a tool exchanging operation may take place.

#### Detailed description of preferred embodiments

*2<sup>nd</sup> boilerplate paragraph*

*Referring now to the drawings, and more particularly to Fig. 1, there is shown*

Fig. 1 illustrates a first simple embodiment of the assembly 1 of the present invention, which includes comprising a support structure 2 carried on a stand 3 that can be positioned close to a workpiece (not shown). The support structure 2 holds a housing 4 with a chips-receiving chamber 5 and one end of an axially expandable and collapsible, tubular member 6, including a helically wound strip of steel or similar strong material so as to form a telescopic spring which is resiliently biased towards its expanded condition shown in Fig. 1. The other end of the tubular member 6 carries a hub portion 7 with a pressure plate P configured to engage a front portion, e.g. an end surface of a spindle, of a cutting machine (not shown). The hub portion 7 is attached to a cross-piece 8 which connects the hub portion 7 to a linear guide unit 9 at one side of the cutting machine for longitudinal guidance of the expansion and collapsing of the tubular member 6. A guide block 9a of the guide unit 9 is supported on a bracket 10 secured to a stationary machine base B. Guide rods 9b attached to the cross-piece 8 are slideable in the guide block 9a. A handle H is attached to the cross-piece 8 for manually compressing the tubular member 6. Alternately, this could be achieved by a pneumatic

cylinder (not shown) which facilitates an exchange of a cutting tool in the machine. A vacuum conduit C is connected to ~~the~~ chips-receiving chamber 5 for removing chips and cuttings from the working area of the workpiece.

*P* In use, ~~the~~ housing 4 is set into engagement with the surface of the workpiece where a hole or recess is to be formed therein. ~~The~~ Telescopic tubular member 6 is allowed to axially expand over the cutting tool and its shaft (not shown) so as to bring ~~the~~ pressure plate P to resiliently engage the advancing spindle of the cutting machine. During the advancement of the cutting tool into the workpiece, ~~the~~ tubular member 6 ~~will~~ axially collapse ~~successively~~ against the action of the spring force of ~~the~~ resilient member 6. ~~The~~ Tubular member 6 forms both a confined space communicating with ~~the~~ chips-receiving chamber 5 so as to improve the evacuation of chips therein, and a strong protection of the cutting tool in a zone between an advancing nose portion of the machine and the workpiece during a working operation.

*FF* Figs. 2 and 3 are perspective views of a second embodiment of ~~the~~ assembly 11 of the *present* invention. ~~The~~ Assembly 11 is adapted to be attached to a front portion of an outer housing 12 of an orbital drilling machine 14 (Fig. 6), or any other type of material working machine for drilling or milling holes or recesses in a workpiece, where cuttings and chips are to be removed from the working area.

*P* ~~The~~ *includes* assembly 11, ~~comprises~~ a U-shaped support structure 16 having two opposed side legs 18 with a rear fastening section 20 for ~~fixating~~ the support structure 16 to the axially movable housing 12 of ~~the~~ machine 14. ~~The~~ Legs 18 are interconnected by a central hub portion 22 which has a cylindrical recess 24 for receiving a front end of an orbiting spindle carrying a rotary cutting tool (not shown) with a small axial play between the bottom of the recess and the end of the spindle. To the outer side of each leg 18 is mounted a respective guide block 26 for linear guidance of two guide rods 28. A cylinder 30 of a pneumatic spring generating a substantially constant spring force is attached to the rear end of each leg 18 and to ~~the~~ guide block 26 and has a piston rod 32 extending through ~~the~~ block 26. ~~The~~ guide rods 28 and ~~the~~ piston rod 32

are fixated to a respective end of a yoke-shaped pressure foot 34, which interconnects the two pairs of guide rods 28 and the piston rods 32. The pressure foot 34 carries a central circular housing 36 defining a chamber 38 for receiving cuttings from the hole or recess being formed in a workpiece against which the pressure foot 34 is biased by the pneumatic springs 30, 32. The chamber 38 communicates with a channel 40, which extends through a branch 42 of the pressure foot 34 and is connected to a vacuum source (not shown) via a tubular outlet socket 44.

R The one end of an axially expandable and collapsible tubular member 46 is attached to the central housing 36, while the other end is attached to the central hub portion 22 of the support structure 16. The tubular member 46 is configured to accommodate the cutting tool and to define a substantially closed space around it, which could be reduced in volume when the cutting tool advances into the workpiece. The tubular member 46 preferably <sup>includes</sup> consists of a telescopic spring made of a helically wound strip 48 of a spring material, such as spring steel. Such a tubular member 46 may easily be collapsed to an axial dimension substantially equal to the width of the strip 48. Alternatively, the tubular member 46 may be formed as a resilient bellows. In its most expanded position the axial length of the tubular member 46 is such that the tip of the cutting tool mounted to the orbiting spindle will not protrude from the surface of the central housing 36 which engages the workpiece.

R When starting a hole-forming procedure, the pressure foot 34 is held at a maximal extended position relative to the drilling machine by means of the pneumatic springs 30, 32. The housing 12 of the orbital drilling machine 14 is fed axially towards the workpiece by an axial feed motor 50 (Fig. 6) until the pressure foot 34 slightly compresses the tubular member 46 when it contacts the surface of the workpiece. During further axial advancement of the cutting tool into the workpiece, the guide blocks 26 will slide forwardly along the guide rods 28 against the constant spring force of the pneumatic springs 30, 32, while collapsing the tubular member 46 axially. Cuttings and chips generated by the cutting tool <sup>are</sup> will be removed by the vacuum source via the chamber 38, channel 40 and the outlet socket 44 during the whole cutting

operation so that the hole will not be jammed thereby and the environment will be protected from being polluted.

*P* Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine 14 coordinated with a third embodiment of a cuttings-removing assembly 52 of the present invention. Figs. 8 and 9 are perspective views of this assembly, seen from the rear side thereof and in an axially collapsed and expanded position, respectively.

*P* In contrast to the second embodiment, ~~the~~ assembly 52 of the third embodiment is configured to be mounted to a support 54, which is fixed relative to ~~the~~ workpiece 56 during the working of a hole therein. ~~The assembly 52 comprises~~ <sup>includes</sup> a central upright member 58 attached to ~~the~~ support 54 via an axially adjustable piston rod 60 (Fig. 10). A cylindrical housing 62 defining a chamber for receiving cuttings from the hole or recess being formed is mounted at the top of ~~the~~ upright 58 facing ~~the~~ workpiece 56. ~~The housing 62~~ has an outlet opening 64 which is connected to a vacuum source via a hose (not shown) for removing the cuttings from the working area. An upper and a lower lateral bracket 66 and 68 are attached to ~~the~~ upright 58 for holding a respective upper and lower, fixed end section 70 of a telescopic pneumatic spring unit 72 and 74. Each spring unit 72, 74 further <sup>includes</sup> ~~comprises~~ three sections 76, 78, 80 which are axially extendable by separate pneumatic cylinders. The outermost sections 80 of the spring units are carrying between them a cross-piece 82 having a central ring-shaped pressure plate 84 to be engaged by the outer end surface 86 of the orbiting spindle of the drilling machine. As best seen in Figs. 7 and 9, ~~the~~ telescoping sections 76, 78, 80 of ~~the~~ spring unit 72 form, in its expanded condition, a stair going downwards, while the corresponding sections of ~~the~~ spring unit 74 form a stair going upwards.

*P* ~~The~~ cross-piece 82 also holds one end 88 of an axially expandable and collapsible tubular member 90, the other end 92 of which is attached to ~~the~~ upright 58 concentrically to housing 62. Like in the first and second embodiments, ~~the~~ tubular member 90 is configured to accommodate the cutting tool and to define a substantially

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closed space around it, which <sup>can</sup> be reduced in volume when the cutting tool advances into the workpiece. Thus, ~~the~~ tubular member 90 preferably <sup>includes</sup> ~~consists of~~ a telescopic spring made of a helically wound strip 94 of a spring material, such as spring steel. Such a tubular member 90 may easily be collapsed to an axial dimension substantially equal to the width of ~~the~~ strip 94.

*PP* The pneumatic spring units 72, 74 are adapted to generate a substantially constant spring force that bias ~~the~~ tubular member 90 towards the end surface 86 of the tool spindle through ~~the~~ pressure plate 84. As shown in Fig. 10, which is a side elevational view showing the mutual positions of ~~the~~ assembly 52 and ~~the~~ drilling machine 14 during a tool changing phase, ~~the~~ telescopic spring sections 76, 78, 80 may be retracted by their respective cylinders to provide a free space between ~~the~~ assembly 52 and the drilling machine for enable easy exchange of the cutting tool.

*PP* ~~It should be noted that the~~ pneumatic springs 30 and spring units 72, 74 referred to above <sup>can</sup> ~~could~~ alternatively be formed as hydraulic or electric units for controlling the expansion and retraction of ~~the~~ tubular member 46, 90.

*boiler-plate  
paragraph*

## Claims

12 1. An assembly for removing chips from a cutting tool working area on a workpiece, comprising: a support structure (2; 16; 54, 58, 60) for supporting a first end of an axially expandable and collapsible tubular member (6; 46; 90); a cross-piece (8; 34; 82) for supporting a second end of the tubular member (2; 46; 90); at least one biasing spring (6; 30, 32; 46; 72, 74; 90) configured and arranged for resiliently biasing the support structure (2; 16; 58) and the cross-piece (8; 34; 82) away from one another, a housing (4; 36; 62) with a chips-receiving chamber (5; 38) located adjacent one of said ends of the tubular member (6; 46; 90) for engagement with the working area of the workpiece, an outlet (C; 40, 44) from the chamber (5; 38) of the housing being configured to be connected to a vacuum source for removing chips from the chamber; and a hub portion (7; 22; 84) located at the other of said ends of the tubular member for engagement with a cutting machine.

13 2. The assembly according to claim 1, wherein the biasing spring itself constitutes the axial expandable and collapsible tubular member (6) and is configured as a telescopic resilient spring made of a helically wound strip.

14 3. The assembly according to claim 1, wherein the support structure (2; 54, 58, 60) is carrying the housing (4; 62) with the chips-receiving chamber (5) and is arranged to be fixated close to the working area of the workpiece, whereas the cross-piece (8; 82) is carrying the hub portion (7; 84) for a biased engagement with the cutting machine.

17 4. The assembly according to claim 1, wherein the cross-piece (34) is carrying the housing (36) with the chips-receiving chamber (38) for a biased engagement with the working area of the workpiece, whereas the support structure (16) is configured to be mounted to an axially movable, non-rotating component (12) of the cutting machine (14) and is carrying the hub portion (22) adjacent a spindle of the cutting machine.

- 15 5. The assembly according to claim <sup>14</sup>7, wherein the at least one biasing spring comprises a pneumatic telescopic cylinder unit (72, 74) attached at one end thereof to the support structure (58) and at the other end to the cross-piece (82).
- 16 6. The assembly according to claim <sup>15</sup>6, wherein one telescopic cylinder unit (72, 74) is arranged on each side of the tubular member (90).
- 16 7. The assembly according to claim <sup>17</sup>7, wherein guide members (26, 28) are attached to the support structure (16) and the cross-piece (34) in order to facilitate a mutual linear displacement of the support structure (16) and the cross-piece (34).
- 19 8. The assembly according to claim <sup>18</sup>7, wherein the support structure (16) comprises a U-shaped bracket having side legs (18) interconnected by the hub portion (22) and provided with a section (20) for fixation of the support structure (16) to a non-rotating component (12) of the cutting machine.
- 20 9. The assembly according to claim <sup>19</sup>8, wherein the cross-piece (34) comprises a yoke member with the housing (36) located centrally on the yoke, said guide members including guide rods (28) attached to opposite end sections of the yoke, and guide blocks (26) attached to the support structure (16) for interaction with the guide rods (28).
- 21 10. The assembly according to any one of claims <sup>19</sup>7-9, wherein the at least one biasing spring comprises a pneumatic telescopic cylinder unit (30, 32) attached at one end thereof to the support structure (16) and at the other end to the cross-piece (22).
- 22 11. The assembly according to claim <sup>21</sup>10, wherein one telescopic cylinder unit (30, 32) is arranged on each side of the tubular member (46).

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Abstract of the invention DISCLOSURE

An assembly for removing chips from a cutting tool working area on a workpiece, <sup>including</sup> comprising: a support structure (16) for supporting a first end of an axially expandable and collapsible tubular member (46); a cross-piece (34) for supporting a second end of the tubular member (46); at least one biasing spring (30, 32) configured and arranged for resiliently biasing the support structure (16) and the cross-piece (34) away from one another; a housing (36) with a chips-receiving chamber (38) located adjacent one of <sup>the</sup> said ends of the tubular member (46) for engagement with the working area of the workpiece, an outlet (40, 44) from the chamber (38) of the housing being configured to be connected to a vacuum source for removing chips from the chamber; and a hub portion (22) located at the other of <sup>the</sup> said ends of the tubular member for engagement with a cutting machine.

**AN ASSEMBLY FOR REMOVING CHIPS FROM A CUTTING WORK AREA OF A  
CUTTING TOOL**

**BACKGROUND OF THE INVENTION**

5    **1. Field of the invention.**

The present invention relates to an assembly for removing chips and cuttings from a cutting working area of a cutting tool on a workpiece. The assembly of the present invention is adapted to be attached to either an axially movable, non-rotating component of a drilling/milling machine, and to be resiliently biased towards a workpiece in which a hole or a recess is formed;  
10 or to be attached to a separate fixed support or stand located close to the workpiece, and to be resiliently biased towards the machine. In particular, but not exclusively, the assembly of the present invention is adapted to be used together with orbital drilling machines.

**2. Description of the related art.**

When forming holes or recesses in a workpiece by way of a drilling or milling machine,  
15 chips and cuttings generated by a cutting tool and remaining in the vicinity of the hole during the forming thereof can adversely effect the surface quality of the hole being formed.

What is needed in the art is a chips-removing assembly, which can efficiently collect and remove chips from a cutting working area while at the same time obtain a full protection of cutting tool in the zone between an advancing nose portion of the machine and the workpiece  
20 during a working operation.

**SUMMARY OF THE INVENTION**

The present invention provides a chips-removing assembly, which can efficiently collect and remove chips from a cutting working area while at the same time obtain a full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece  
25 during a working operation.

The invention comprises, in one form thereof, a support structure for supporting a first end of an axially expandable and collapsible tubular member; a cross-piece for supporting a second end of the tubular member; at least one biasing spring configured and arranged for resiliently biasing the support structure and the cross-piece away from one another; a housing  
5 with a chips-receiving chamber located adjacent one of the ends of the tubular member for engagement with the working area of the workpiece, an outlet from the chamber of the housing being configured to be connected to a vacuum source for removing chips from the chamber; and a hub portion located at the other of the ends of the tubular member for engagement with a cutting machine. During the working operating the tubular member surrounds the shaft of the  
10 cutting tool and defines a space which is substantially closed against a nose portion (e.g. a rotating spindle) of the working machine and which communicates with the chips-receiving chamber so as to improve the evacuation of chips therein and to create a safe protection for the operator in case of a breakdown of the cutting tool.

An advantage of the present invention is that chips and cuttings from a cutting work area  
15 are efficiently removed.

Another advantage of the present invention is that it provides a full protection of the cutting tool in the zone between an advancing nose portion of the machine and the workpiece during a working operation.

Yet another advantage of the present invention is an improved surface quality of the hole  
20 being formed.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood

by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective view of a first embodiment of the assembly of the present invention;

5 Fig. 2 is perspective view of a second embodiment of the assembly of the present invention, as seen from a frontal side;

Fig. 3 is perspective view of the second embodiment of Fig. 2 as seen from a rear side;

Fig. 4 is an end view of the second embodiment of Fig. 2;

Fig. 5 is a cross-sectional view taken along the line A-A in Fig. 4;

10 Fig. 6 is a perspective view of an orbital drilling machine to which the assembly of Figs. 2-5 is attached.

Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine coordinated with a third embodiment of a cuttings-removing assembly of the present invention;

15 Figs. 8 and 9 are perspective views of the assembly of Fig. 7, seen from the rear side thereof and in an axially collapsed and expanded position, respectively; and

Fig. 10 is a side view of a front portion of an orbital cutting machine and the third embodiment of the assembly in a retracted, unexpanded position in which a tool exchanging operation may take place.

20 Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate one preferred embodiment of the invention, in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

### DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and more particularly to Fig. 1, there is shown a first embodiment of assembly 1 of the present invention, which generally includes a support structure 2 carried on a stand 3 that can be positioned close to a workpiece (not shown). Support structure 2 holds a housing 4 with a chips-receiving chamber 5 and one end of an axially expandable and collapsible, tubular member 6 including a helically wound strip of steel or similar strong material so as to form a telescopic spring which is resiliently biased towards its expanded condition shown in Fig. 1. The other end of tubular member 6 carries a hub portion 7 with a pressure plate P configured to engage a front portion, e.g. an end surface of a spindle, of a cutting machine (not shown). Hub portion 7 is attached to a cross-piece 8 which connects hub portion 7 to a linear guide unit 9 at one side of cutting machine for longitudinal guidance of the expansion and collapsing of tubular member 6. A guide block 9a of guide unit 9 is supported on a bracket 10 secured to a stationary machine base B. Guide rods 9b, attached to cross-piece 8, are slideable in guide block 9a. A handle H is attached to cross-piece 8 for manually compressing tubular member 6. Alternately, this is achieved by a pneumatic cylinder (not shown) which facilitates an exchange of a cutting tool in the machine. A vacuum conduit C is connected to chips-receiving chamber 5 for removing chips and cuttings from the working area of the workpiece.

In use, housing 4 is set into engagement with the surface of the workpiece where a hole or recess is to be formed therein. Telescopic tubular member 6 is allowed to axially expand over the cutting tool and its shaft (not shown) so as to bring pressure plate P to resiliently engage the advancing spindle of the cutting machine. During the advancement of the cutting tool into the workpiece, tubular member 6 axially collapses successively against the action of the spring force of resilient member 6. Tubular member 6 forms both a confined space communicating with the chips-receiving chamber 5 so as to improve the evacuation of chips therein, and a strong

protection of the cutting tool in a zone between an advancing nose portion of the machine and the workpiece during a working operation.

Figs. 2 and 3 are perspective views of a second embodiment of assembly 11 of the present invention. Assembly 11 is adapted to be attached to a front portion of an outer housing 12 of an orbital drilling machine 14 (Fig. 6), or any other type of material working machine for drilling or milling holes or recesses in a workpiece, where cuttings and chips are to be removed from the working area.

Assembly 11 includes a U-shaped support structure 16 having two opposed side legs 18 with a rear fastening section 20 for fixating support structure 16 to the axially movable housing 12 of machine 14. Legs 18 are interconnected by a central hub portion 22 which has a cylindrical recess 24 for receiving a front end of an orbiting spindle carrying a rotary cutting tool (not shown) with a small axial play between the bottom of the recess and the end of the spindle. To the outer side of each leg 18 is mounted a respective guide block 26 for linear guidance of two guide rods 28. A cylinder 30 of a pneumatic spring generating a substantially constant spring force is attached to the rear end of each leg 18 and to guide block 26 and has a piston rod 32 extending through block 26. Guide rods 28 and piston rod 32 are fixated to a respective end of a yoke-shaped pressure foot 34, which interconnects the two pairs of guide rods 28 and piston rods 32. Pressure foot 34 carries a central circular housing 36 defining a chamber 38 for receiving cuttings from the hole or recess being formed in a workpiece against which pressure foot 34 is biased by pneumatic springs 30, 32. Chamber 38 communicates with a channel 40, which extends through a branch 42 of pressure foot 34, and is connected to a vacuum source (not shown) via a tubular outlet socket 44.

The one end of an axially expandable and collapsible tubular member 46 is attached to central housing 36, while the other end is attached to central hub portion 22 of support structure

16. Tubular member 46 is configured to accommodate the cutting tool and to define a substantially closed space around it, which could be reduced in volume when the cutting tool advances into the workpiece. Tubular member 46 preferably includes a telescopic spring made of a helically wound strip 48 of a spring material, such as spring steel. Such a tubular member  
5 46 may easily be collapsed to an axial dimension substantially equal to the width of strip 48. Alternatively, tubular member 46 may be formed as a resilient bellows. In its most expanded position the axial length of tubular member 46 is such that the tip of the cutting tool mounted to the orbiting spindle will not protrude from the surface of central housing 36 which engages the workpiece.

10 When starting a hole-forming procedure, pressure foot 34 is held at a maximal extended position relative to the drilling machine by way of pneumatic springs 30, 32. Housing 12 of orbital drilling machine 14 is fed axially towards the workpiece by an axial feed motor 50 (Fig. 6) until pressure foot 34 slightly compresses tubular member 46 when it contacts the surface of the workpiece. During further axial advancement of the cutting tool into the workpiece, guide  
15 blocks 26 slides forwardly along guide rods 28 against the constant spring force of pneumatic springs 30, 32, while collapsing tubular member 46 axially. Cuttings and chips generated by the cutting tool are removed by the vacuum source via chamber 38, channel 40 and outlet socket 44 during the whole cutting operation so that the hole will not be jammed thereby and the environment will be protected from being polluted.

20 Fig. 7 is a perspective view similar to Fig. 6 and illustrates a similar orbital drilling machine 14 coordinated with a third embodiment of a cuttings-removing assembly 52 of the present invention. Figs. 8 and 9 are perspective views of this assembly, seen from the rear side thereof and in an axially collapsed and expanded position, respectively.

In contrast to the second embodiment, assembly 52 of the third embodiment is configured to be mounted to a support 54, which is fixed relative to workpiece 56 during the working of a hole therein. Assembly 52 includes a central upright member 58 attached to support 54 via an axially adjustable piston rod 60 (Fig. 10). A cylindrical housing 62 defining a chamber for receiving cuttings from the hole or recess being formed is mounted at the top of upright 58 facing workpiece 56. Housing 62 has an outlet opening 64 which is connected to a vacuum source via a hose (not shown) for removing the cuttings from the working area. An upper and a lower lateral bracket 66 and 68 are attached to upright 58 for holding a respective upper and lower, fixed end section 70 of a telescopic pneumatic spring unit 72 and 74. Each spring unit 72, 74 further includes three sections 76, 78, 80 which are axially extendable by separate pneumatic cylinders. The outermost sections 80 of the spring units are carrying between them a cross-piece 82 having a central ring-shaped pressure plate 84 to be engaged by the outer end surface 86 of the orbiting spindle of the drilling machine. As best seen in Figs. 7 and 9, telescoping sections 76, 78, 80 of spring unit 72 form, in its expanded condition, a stair going downwards, while the corresponding sections of spring unit 74 form a stair going upwards.

Cross-piece 82 also holds one end 88 of an axially expandable and collapsible tubular member 90, the other end 92 of which is attached to upright 58 concentrically to housing 62. Like in the first and second embodiments, tubular member 90 is configured to accommodate the cutting tool and to define a substantially closed space around it, which can be reduced in volume when the cutting tool advances into the workpiece. Thus, tubular member 90 preferably includes a telescopic spring made of a helically wound strip 94 of a spring material, such as spring steel. Such a tubular member 90 may easily be collapsed to an axial dimension substantially equal to the width of strip 94.

Pneumatic spring units 72, 74 are adapted to generate a substantially constant spring force that bias tubular member 90 towards the end surface 86 of the tool spindle through pressure plate 84. As shown in Fig. 10, which is a side elevational view showing the mutual positions of assembly 52 and drilling machine 14 during a tool changing phase, telescopic spring sections 76, 78, 80 may be retracted by their respective cylinders to provide a free space between the assembly 52 and the drilling machine for enable easy exchange of the cutting tool.

Pneumatic springs 30 and spring units 72, 74 referred to above can alternatively be formed as hydraulic or electric units for controlling the expansion and retraction of tubular member 46, 90.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

**ABSTRACT OF THE DISCLOSURE**

An assembly for removing chips from a cutting tool working area on a workpiece, including a support structure for supporting a first end of an axially expandable and collapsible tubular member; a cross-piece for supporting a second end of the tubular member; at least one  
5 biasing spring configured and arranged for resiliently biasing the support structure and the cross-piece away from one another; a housing with a chips-receiving chamber located adjacent one of the ends of the tubular member for engagement with the working area of the workpiece, an outlet from the chamber of the housing being configured to be connected to a vacuum source for removing chips from the chamber; and a hub portion located at the other of the ends of the  
10 tubular member for engagement with a cutting machine.